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THE PRIMORDIAL FAUNA

AND THE

TACONIC SYSTEM,

By JOACHIM BARRANDE.

WITH ADDITIONAL NOTES,

By JULES MARCOU.

[*From the Proceedings of the Boston Society of Natural History, Vol. vii.
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The discovery of *Paradoxides Harlani* at Braintree, and that of *Paradoxides Bennetti* and *Conocephalites* at St. Mary's Bay, Newfoundland, in slates until then regarded as Azoic and placed among the crystalline and primary rocks, show plainly that the Primordial fauna is represented also on the Atlantic coast of North America. These are not isolated facts, but rather two landmarks showing the existence of strata occupying an important place in the system of stratified rocks.

In a letter dated Paris, 29th May, 1860, M. Barrande says:—

"If you see Prof. W. B. Rogers I beg you to thank him for his three beautiful photographs of *Paradoxides Harlani* (Green,) which he was

so kind as to send me. They were very interesting to our Geological Society (of France) where I showed them, stating that this species is identical with *P. spinosus* of Bohemia. This is a very important fact, and should have a happy result, that of establishing the relative age of the most ancient formations on the two continents."

In his note "On the *Primordial Fauna*," (see "*Bul. de la Soc. Géol. de France*," vol. XVII. p. 551,) M. Barrande gives it as his opinion that the *P. Bennetti*, though differing from the *P. spinosus* of Bohemia, belongs to the same group of fossils.

This being established, let us proceed a little farther and see if previous discoveries and published records permit the extension of the Primordial fauna over some other portions of North America.

Prof. E. Emmons in his geological survey of Lake Champlain, as far back as 1838, recognized below the Potsdam sandstone a series of strata, which he described at length in 1844, and named the *Taconic System*. The fossils then found by Prof. Emmons were few in number and so badly preserved that some doubts may have been entertained at that time as to their determination and value as characteristic fossils. Nevertheless, his *Eliptocephalus asaphoides* was a Trilobite form so different from those known in the other strata of New York, that a skilful paleontologist would not have let it pass without further inquiry.

The principal argument of Prof. Emmons was based on stratigraphical and lithological grounds, and the numerous sections and descriptions of rocks accompanying his Taconic system are certainly conclusive, so far as geognostical characters are concerned. The paleontologist of the State of New York rejected the Taconic system, and, siding with other opponents of Prof. Emmons's discovery, in his first volume of the "Paleontology of New York," (1847,) Mr. James Hall assigns the age of the *Hudson River* group to the strata of the *Taconic system*, explaining the difference of lithological characters by metamorphisms, the discordance of stratification and the different thickness of the strata by folding and faults; the fossils he regards as badly determined. His opinions are not supported by detailed sections, but he refers to the *Introduction* of his work for explanation, which *Introduction* as yet remains unpublished.

Since 1844 Prof. Emmons has continued his observations and discoveries on those *bottom rocks*, and in 1855 he gave a more complete account of his Taconic system in the second part of his "American Geology." This book has unfortunately escaped M. Barrande's inquiries, for his attention would be strongly drawn to the new Taconic fossils it contains. It is evident from the new specimen of *Eliptocephalus asaphoides*, from the shales of Washington County, New York, figured Pl. I, fig. 18, that this trilobite is a *Paradoxides* related to the group of *P. spinosus*, perhaps identical with the *P. Harlani* of Braintree. Besides, the trilobite figured Pl. I, fig. 16, and called *Atops trilineatus*, is a true *Sao*, which genus is among the most characteristic of the Primordial fauna of Bohemia and Scandinavia. Prof. Emmons has thus found at least two trilobites of the Primordial fauna in slates forming part of his Taconic System. Trilobites are the most important fossils for the determination of the age of the oldest strata; the labors of M. M. Barrande and Angelin have shown with what certainty geologists can rely upon them. Other less significant fossils have been found by Emmons, such as *Graptolites*, *Lingulæ*, and *Obolæ*. Sections and very detailed descriptions of strata show that the Taconic system, as defined by its discoverer, is composed of shales, slates, limestones, dolomites, conglomerates, sandstones, and iron breccia, whose combined thickness is between 25,000 and 30,000 feet, always resting on granite, gneiss, quartzite, and other crystalline rocks; that it lies at the base of the Silurian (such as the Silurian was first established in England and in America); and that this *bottom formation* extends, according to Emmons himself, from Newfoundland to Maine, Canada, Vermont, Massachusetts, Rhode Island, and along the Alleghanies to Georgia.

A discovery made some time since, but only published last year, has brought before the scientific world new forms of fossils, which, according to M. Barrande, unquestionably belong to the Primordial fauna. The following is the statement of M. Barrande, contained in a letter to Prof. Bronn of Heidelberg, to be published in the German Geological Journal: "*Neues Jahrbuch für Geologie und Petrefakten Kunde*."

"Paris, July 16, 1860."

" I have recently received, thanks to the kindness of M. E. Billings, the learned paleontologist of the Geological Survey of Canada,

a very interesting pamphlet entitled 'Twelfth Annual Report of the Regents of the University of the State of New York, 1859.' If you possess this publication, you will find there, at page 59, a memoir of Prof. J. Hall, entitled 'Trilobites of the Shales of the Hudson River Group.' This savant there describes three species under the names *Olenus Thompsoni*, *Olenus Vermontana*, and *Peltura (Olenus) holopyga*. The well-defined characters of these trilobites are described with the clearness and precision to be expected from so skilful and experienced a paleontologist as James Hall.

"Although the specimens are incomplete, their primordial nature cannot admit of the least doubt, when the descriptions are read, accompanied with wood engravings which the large dimensions of these three species render sufficiently exact. The first is 105 millim. long by 80 broad, the other two are somewhat smaller.

"The heads of the two *Oleni* being deteriorated, the furrows of the glabella cannot be recognized. The thorax has a common and remarkable character, which consists in the greater development of the third segment, the point of which is stronger and longer than in all the other pleura. This is a striking resemblance to the *Paradoxides*, the second segment of which has the same peculiarity. Besides, there is an intimate relation between these two primordial types, and we should not be surprised if America furnished us with forms uniting most of their characteristics. The pygidium of *O. Thompsoni*, the only one that is known, shows no segmentation, and attests by its exiguity its relation to a primordial trilobite. *P. holopyga*, by its whole appearance, resembles the species of Sweden so well known by the name of *P. Scarabæoides*.

"Thus all the characters of these three trilobites, as they are recognized and described by J. Hall, are those of the trilobites of the primordial fauna of Europe. This is so true, that I think I may say without fear, if M. Angelin, or any other paleontologist practised in distinguishing the trilobites of Scandinavia, had met with these three American forms in Sweden or Norway, he would not have hesitated to class them among the species of the Primordial fauna, and to place the schists enclosing them in one of the formations containing this fauna. Such is my profound conviction, and I think any one who has made a serious study of the trilobitic forms and of their vertical distribution in the oldest formations will be of the same opinion.

"Besides, all who have seriously studied paleontology know well that each geological epoch, or each fauna, has its proper and characteristic forms, which once extinct reappear no more. This is one of the great and beautiful results of your immense researches, which have generalized this law, recognized by each one of us within the limits of the strata he describes.

"The great American paleontologist arrived long since at the same conclusion, for in 1847 he wrote the following passage in the *Introduction* to the first volume of the Monumental Work consecrated to the Paleontology of New York.

"Every step in this research tends to convince us that the succession of strata, when clearly shown, furnishes conclusive proofs of the existence of a regular sequence among the earlier organisms. We are more and more able, as we advance, to observe that the Author of nature, though always working upon the same plan and producing an infinite variety of forms almost incomprehensible to us, has never repeated the same forms in successive creations. The various organisms called into existence have performed their parts in the economy of creation, have lived their period and perished. This we find to be as true among the simple and less conspicuous forms of the paleozoic series, as in the more remarkable fauna of later periods.' — J. Hall, '*Pal. of New York*,' I. p. XXIII."

"When an eminent man expresses such ideas so eloquently, it is because they rise from his deepest convictions. It must then be conceived that J. Hall, restrained by the artificial combinations of stratigraphy previously adopted by him, has done violence to his paleontological doctrines, when, seeing before him the most characteristic forms of the *Primordial fauna*, and giving them names the most significant of this first creation, he thinks it his duty to teach us that these three trilobites belong to a horizon *superior* to that on which the second fauna is extinguished.

"In effect, according to the text of J. Hall, the three trilobites in question were found near the town of Georgia, Vermont, in schists which are superior to the *true Hudson River group*. In his works J. Hall does not go beyond indicating the horizon of certain fossils, and no one would think of asking a guaranty for such indications. But on this occasion the great American paleontologist thinks it necessary to support his stratigraphical determination by another authority, chosen from the most respectable names in geology. The following is the note which terminates his Memoir.

"NOTE.—In addition to the evidence heretofore possessed regarding the position of the shales containing the Trilobites, I have the testimony of Sir W. E. Logan, that the shales of this locality are in the upper part of the Hudson River group, or forming a part of a series of strata which he is inclined to rank as a distinct group, above the Hudson River proper. It would be quite superfluous for me to add one word in support of the opinion of the most able stratigraphical geologist of the American continent."

"Now, when a savant like J. Hall thinks himself obliged to invoke

testimony to guarantee the exactness of the position of a few fossils, it is clear that the determination of this position is difficult.

"In order to understand these difficulties I have consulted the maps and documents relating to the State of Vermont and the country in which the town of Georgia is situated, and, although the library of our Geological Society does not contain all that one could wish on this subject, I recognized easily that Georgia is placed in the region where the order of succession of the deposits is the most obscured by foldings and dislocations; so that the position of the schists in question could not have been determined by the incontestable evidence of direct superposition. Besides, the physical appearance of these schists is not that of the rocks constituting the typical group of Hudson River. This is verified by the Note of J. Hall, for it tells us that Sir W. E. Logan is inclined to make a distinct group of these schists *superior* to that of the Hudson, and which consequently *would crown the whole Lower Silurian division of the continent*.

"For the above reasons, the geological horizon on which the three *Oleni* of Georgia were found appears to me to have been but uncertainly determined at first view, and even in complete opposition to paleontological documents.

"I do not think, then, that I weaken in the least degree the respect and confidence justly inspired by the labors of the American savants whose names have just been mentioned, when I ask them in the name of science to make new researches and new studies, that may lead to a final and certain solution of this important question.

"Doubtless, thanks to the progress of our knowledge, we are now no longer bound by the ancient conception of the simultaneous extinction and the total renovation of the faunæ. For myself, in particular, it would not be possible to accuse me of similar views at the moment when I publish the explanation of my doctrine of colonies. But you will perceive that the facts which I invoke in support of this doctrine are far from sustaining the reappearance of a fauna after the extinction of the following fauna, which the three trilobites of Georgia would do, if they had really lived after the deposit of the Hudson River group.

"This reappearance would be still more astonishing, as among the three great Silurian faunæ the second fauna occupies the greatest vertical space and is probably the one which enjoyed the longest existence. Thus, to verify such a reappearance, the most incontestable proofs are required, for such a decision would oblige the entire re-formation of one of our most important scientific creeds.

"Yours very truly,

"J. BARRANDE."

Prof. Emmons has always regarded these black slates of Georgia as part of his Taconic system, and more, he refers them to the base of the upper division of the Taconic rocks (see "*American Geology*," part II. p. 49). The strata are dislocated and upheaved at Georgia, and as far as my knowledge of the geology of the vicinity of Burlington, Isle La Motte, Chazy, and Rouse's Point extends, acquired in an exploration of a few days in 1849, I am far from agreeing with the statement made by Messrs. Logan and Hall that the strata of Georgia are of the age of the Hudson River group. Mr. Emmons, I think, rightly refers them to the Taconic system, and the discovery of the three primordial trilobites confirms the view arrived at by him only through their stratigraphical and lithological characters.

In another letter, dated Paris, 14th August, 1860, M. Barrande says : —

" You will easily perceive the interest and importance of the question, even if it were only raised on account of the three *Oleni* of Georgia ; but it takes in now a much wider field, owing to a letter I have just received from Mr. Billings, official paleontologist of the Geological Survey of Canada, who informs me that he has found lately, in the schists and limestones near Quebec, considered as being the prolongation of those in question in Vermont, nearly one hundred species, almost all new. Twenty-six of these come from a white limestone, and seem to him to be the true representatives of the Primordial fauna, and he cites among them *Conocephalites*, *Arionellus*, *Dikellocephalus*, etc., that is, very characteristic forms of this fauna.

" In another limestone, which is gray, he finds thirty-nine species, all different from the first, and representing, on the contrary, the most distinct types of the second fauna. Finally, the black schists furnish him with *Graptolites*, *Lingulæ*, etc., etc., fossils which at first sight cannot determine a horizon, because they are found upon several Silurian horizons.

" While waiting for the very obscure stratigraphical relations to be disentangled, and without engaging in any manner Mr. Billings, who should preserve the independence of his opinion, I may yet express to you my view wholly personal, and of which at this moment I take the entire responsibility. I think, then, that this region of schists and limestones of Vermont, in other words the *Taconic system*, will reproduce in America that which took place in England as to the Malvern Hills, and in Spain for the Cantabrian chain, — that is to say, the Primordial

fauna, after having been disregarded, will regain its rights and its place, usurped by the second fauna.

"You see it is a great and noble question, whose final solution will complete the imposing harmonies existing already between the series of paleozoic faunæ of America and that of the contemporaneous faunæ of Europe, leaving to each the imprint peculiar to its continent.

"I can well imagine, from the position previously taken by our learned American brothers on the subject of the Taconic system, that the final solution of which I speak will not be obtained without debate, and perhaps some wounding of self-love, for some opinions that appear to be dominant must be abandoned.

"But experience has taught me that in such cases the most elevated minds turn always first to the light, and put themselves at the head of the movement of reform. Thus, when in 1850 I recognized the Primordial fauna in the Malvern Hills, where the second fauna only had been found, Sir Henry de la Beche and Sir Roderick Murchison were the first to adopt my views, to which little by little the other official geologists agreed; Ed. Forbes ranged himself publicly on my side in 1853 in 'The Geological Survey,' while others still hesitated, and now there is no longer any opponent.

"I think it will be nearly the same in America, and that in some years from now the opinions of your savans will have undergone a great change as regards this question.

"It is a fine opportunity for Dr. Emmons to reproduce his former observations and ideas with more success than in 1844.

"Yours very truly,

"J. BARRANDE."

I would add to the above letter a few words on the geology of the vicinity of Quebec. Twelve years ago I passed a few days in that region, and my opinion, formed from my own observations made at that time, differs wholly from the publications of Mr. Logan and Dr. Bigsby on the subject. Dr. Bigsby (*On the Geology of Quebec and its environs*, "Quart. Journ. of the Geol. Soc. of London," vol. IX. p. 82, 1853,) refers all the strata, except a narrow band of limestone north of Quebec, to the Hudson River group; the limestone band extending from Montmorency to Indian Lorette is determined by him as Trenton limestone. The fossils upon which he relies for placing the Quebec strata in the Hudson River group are only a few *Graptolites*. Dr. Bigsby admits that the Hudson River group is enormously developed in that part of North America, that it is composed of rocks almost azoic, and that he does not understand

clearly how what he calls the Hudson River group came to be conformable to the gneiss, with two unconformable and widely different strata of great thickness interposed. Mr. Logan is of the same opinion as Dr. Bigsby on the age of the strata in the vicinity of Quebec, and moreover he gives an explanation of what puzzled the Dr. so much. In his "*Report of Progress for the year 1852-3*," p. 35 and 36, Mr. Logan explains the discordance of stratification between the Trenton limestone and the Quebec bituminous black and gray slates, by an *anticlinal axis* complicated by a *fault*. It must be observed that Mr. Logan admits that he cannot give any precise facts by which to determine the position of the anticlinal. I quote his description of the Montmorency Falls section.

"The details of the fault are well displayed at Montmorency Falls; here the channel of the river is cut down through the black limestone beds of the Trenton formation to the gneiss of the anticlinal ridge, and the water at and below the bridge flows down and across the gneiss, and leaps at one bound to the foot of a precipice, which, immediately behind the water, is composed wholly of this rock. At the summit of the cascade, the Trenton beds on each side have a thickness of almost fifty feet, and they are marked by *Trinucleus concentricus*, *Calymene senaria*, *Conularia quadrisulcata*, *Leptaena sericea*, *L. deltoidea*, *Orthis testudinaria*, and *Lingula*. The dip of these beds is down the stream at a very small angle; but at the foot of the precipice, and in immediate contact with the gneiss, about the same thickness of limestone is tilted up to an angle of fifty-seven degrees; it is followed by a similar amount of black bituminous shale with the same slope; in this attitude these rocks climb up the face of the precipice, presenting their edges to the chasm on each side. They are followed by about eight feet of strong hard gray sandstone, weathering brown, in beds of ten to eighteen inches, interstratified with black shales, to which again succeed gray arenaceous-argillaceous shales, composing the sides of the chasm, out to the waters of the St. Lawrence. The limestones belong to the Trenton, the black shales to the Utica formation, and the gray to the Loraine shales."

When at Montmorency Falls, 28th Sept. 1849, I made the following notes. The fall is formed by a quartzite rock passing to mica-schist (gneiss of Messrs. Logan and Bigsby) with traces of substratification, and running east 20° north, to west 20° south; at the foot of the fall and in contact with the quartzite there is a

series of black bituminous slates, with intercalations now and then, more especially near the base of the fall, of small beds of limestone. This system of slate is strongly upheaved, the beds dipping east east south at an angle of 60° , and near the foot of the fall they are almost vertical. They form a sort of amphitheatre around the falls and are prolonged toward the St. Lawrence River, disappearing beneath the water and reappearing at the Isle of Orleans. I find no fossils in this system. The upper part of the fall is formed by a series of blue limestone 40 or 50 feet in thickness, almost horizontal near the bridge, but inclined from 10° to 15° east east south, on the left side of the fall near the chasm. This limestone, which is a little marly, rests directly on the quartzite rocks; it contains immense numbers of ramose corals, which were submitted in 1850 to Milne Edwards and Jules Haime, and were identified by those learned paleontologists with the *Alveolites repens* (Foug.) of the Upper Silurian of Dudley and Wenlock in England and of Gothland in the Baltic, and nearly related to, if not identical with, a ramose coral of the Niagara group at Lockport. The *Alveolites repens* was the only fossil found by me at Montmorency, and was noted with the suggestion that the limestone belongs to the Trenton or perhaps the Niagara group. The quartzite and mica-schist *have upheaved the bituminous black slates, and the almost horizontal strata of limestone have been deposited after the dislocation.* This description of Montmorency Falls differs widely from the description published by Mr. Logan, and, now that the question of the Primordial fauna and the Taconic system is brought forward, I have no doubt that those black slates at the foot of Montmorency Falls, the strata of the Isle d'Orleans, the city of Quebec, the Plains of Abraham, Point Levi, all the south shore of the St. Lawrence going up the Chaudière River as far at least as the Chaudière Falls, which are all strongly elevated, dislocated, and follow the general direction east 20° north to west 20° south, belong to the Taconic system of Vermont and Eastern New York, and that in this system the fossils belonging to the Primordial fauna have been found. I did not see the anticlinal axis with fault, described by Mr. Logan, and I explain the relations of the rocks by a *discordance* of stratification, caused by upheaval an-

terior to the deposit of the Montmorency Bridge limestone. At Indian Lorette the section is almost identical with that of the Montmorency Falls. In the direction of Beauport I picked up in some limestone quarries several brachiopoda which resemble Trenton brachiopoda, but they were never determined in a regular way. They are now in the collection of the *Jardin des Plantes* at Paris, with my other gatherings in North America during the years 1848, '49, and '50.

Mr. Salter, who has examined the fossils picked up by Dr. Bigsby at Montmorency, Beauport, and Indian Lorette, regards them as indicating the Trenton limestone, and Mr. Logan gives a list of fossils indicating for the limestone at the summit of the cascade the Trenton age. In accordance with these two geologists, I regard those horizontal beds of limestone as representing the Trenton limestone of New York, although I think the presence of the *Alveolites repens*, an Upper Silurian coral, in those rocks, requires further inquiry before arriving at a final conclusion on all the rocks found at Montmorency.

The fifty feet of limestone pointed out by Mr. Logan at the foot of the fall, and in immediate contact with the gneiss, I did not see, and it is difficult for me to believe that fifty feet of limestone could have escaped my notice when my attention was entirely fixed on the stratigraphical phenomena of the section of Montmorency Falls. But it is such a celebrated place for excursions and of such easy access, that the verification of the question by a geologist can readily be made. Even if these fifty feet of limestone are there, it is to be proved that they contain Trenton fossils, which Mr. Logan does not say.

Messrs. Logan and Hunt, in previous works, ("Report of Progress of the Geological Survey of Canada, for the year 1847-48," and, "*Esquisse Géologique du Canada, avec une Carte Géologique du Canada*," Paris, 1855,) have described and colored all the country east of Montreal, between Lake Champlain and Quebec, as occupied exclusively by strata of the age of the *Hudson River group* and *Oneida sandstone*, or *Richelieu slates* and *Sillery formation*, with some patches of *Trenton limestone*. It is certain that the *Taconic system* occupies the main part of the country, and that the geological map of Lower Canada is to be greatly modified to be put in harmony with the Primordial fauna formation.

I have been informed lately that Messrs. Logan, Hunt, and Hall maintain the age of the Hudson River group for the strata of Quebec and Georgia on stratigraphical grounds, which to Mr. Logan are very clear; and that they are disposed to think the so-called Primordial fauna extends much higher in Canada than in Europe, and has *reappeared after a first extinction*. Such a decision should not be reached without the most decisive proofs, for it breaks through the laws of paleontology, and annihilates almost all the results arrived at by the labors of Smith, Cuvier, Brongniart, De Buch, D'Orbigny, Agassiz, Barrande, etc., for the last fifty years. Nor is this the first attempt of geologists recognizing Mr. James Hall as their leader against the recognized laws of paleontology. During the last six years they have placed an Oligocene flora *below* the cretaceous rocks, a Triassic flora *among* what they call Jurassic rocks, Jurassic fossils *in* cretaceous rocks, the mountain limestone fauna *above* the coal-measures, cretaceous fossils *in* Triassic rocks, etc. etc.

There is at least one proof that Messrs. Hall, Logan, and Hunt can give, to show that the Primordial fauna extends over the second fauna, — it is to show, in those parts of New York where the strata are without dislocation and succeed regularly, such as Utica, Loraine, Pulaski, and the neighborhood of Rome, that the Primordial fauna is *above the second fauna*.

There is only one point on which I differ from Prof. Emmons, — it is as to the propriety of placing the Potsdam sandstone as the *base* of the Silurian. Until now not a single fossil of the Calciferous sandrocks, of the Black River group, or of the Trenton group, has been found in the Potsdam of the State of New York; on the contrary, it contains the Primordial fauna, such as *Conocephalites*, *Dikellocephalus*, *Orthis*, and *Lingula*. Thus, the Potsdam group is paleontologically entirely independent of the Lower Silurian, while it possesses fossils belonging to the Taconic system. I am not sufficiently acquainted with its distribution and position as regards the Taconic and the Calciferous sandrocks to give a decided opinion based on stratigraphical grounds, but from the description of Prof. Emmons in his *Taconic system*, and from what I have seen at Little Falls, the Calciferous sandrocks are certainly very differently distributed from the Potsdam, and a dislocation and disturbance of strata have taken

place between the two groups. Instead of regarding the Potsdam as the *first* term of the Silurian rocks, I think it is the *last* one of the Taconic system, which changes its place of *bottom rocks* containing fossil remains into that of *cover*, capping a system of 30,000 feet of fossiliferous strata, containing at different levels, especially the upper half, the remains of organic beings left by the Primordial fauna.

The Taconic system, contrary to the other members of the Paleozoic series of North America, has been subjected to dislocations on a vast scale, and presents almost always strata upheaved, broken up, and in the most disturbed state, with the exception of the upper portion or Potsdam group. Generally, along the Alleghany range, the Lower Silurian rocks follow immediately; although in Canada, Vermont, and New York, patches of Hudson River group, Utica slate, Trenton limestone, Chazy limestone, and Calciferous sandrocks, indicate that the Lower Silurian strata have recovered in discordance of stratification some parts of the country where the Taconic strata were upheaved and dislocated. In Pennsylvania, Virginia, and North Carolina, New Red Sandstone covers the Taconic strata, probably, also, in Maine and New Brunswick. In the elevation of land comprised between the Upper Mississippi, Lake Superior, and Lake Michigan, the Taconic system is well developed, resting on granite; it is formed of slates, mica-schists, quartzites, limestones, iron breccia, and is terminated by what D. D. Owen has called *Lower sandstone of the Upper Mississippi*, or *formation I*. Until now, fossil remains have only been found in the upper part of the system, on the St. Croix River, where Mr. Owen has indicated and described Trilobites and Lingulæ, indicating the Primordial fauna. Fragments of Primordial Trilobites, and Lingulæ, have also been found near Lake Michigan, and on the Menomonee and Escanaba rivers. On the southern part of the elevation of land alluded to, the Taconic strata are followed and recovered by the Silurian rocks, while on the northern part, that is to say, in the Lake Superior direction, they are covered in *discordant stratification*, as in North Carolina, by the *Triassic strata* of the Lake Superior sandstone formation. Taconic strata exist also on the northern shore of Lake Superior, especially near the Pic and

Gros Cap, where slates are found intercalated between granite and gneiss rocks.

Farther west, in the Black Hills of Nebraska, Dr. Hayden has recognized the Primordial fauna in a series of sandstone rocks, resting on slates, mica-schists, and azoic rocks. Dr. Ferdinand Roemer, in his exploration of Texas (*"Die Kreidebildungen von Texas und ihre organischen Einschlüsse"* Bonn, 1852), has described trilobites from the San Sabaz, which M. Barrande refers to the Primordial fauna; and Dr. B. F. Shumard has since discovered in the same region of Texas, trilobites of the genus *Arionellus*, *Lingulæ*, *Obolus*, and *Orthis*, which leave no doubt of the existence of the Taconic system in Texas (*"Trans. of the Acad. of St. Louis,"* p. 673, 1860). Even from the small notice of Dr. Shumard, it appears that the Primordial fauna of Texas is almost identical with the one just discovered in the Cantabrian Chain of Spain by Casiano de Prado, (*"Bull. de la Soc. Géol. de France,"* p. 516, vol. XVII., 1860).